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(71) Applicant: VERTIZON CORPORATION [US/US]; P.O. Box 81, No. Reading, MA 01864 (US).

(72) Inventors: NELSON, Avi, N.; P.O. Box 81, No. Reading, MA 01864 (US). GOOR, Daniel; 4143 Sinton Road, G.A.I., Colorado Springs, CO 80907 (US).

(74) Agents: PAUL, Edwin, H. et al.; Perkins, Smith & Cohen, LLP, One Beacon Street, Boston, MA 02180 (US).

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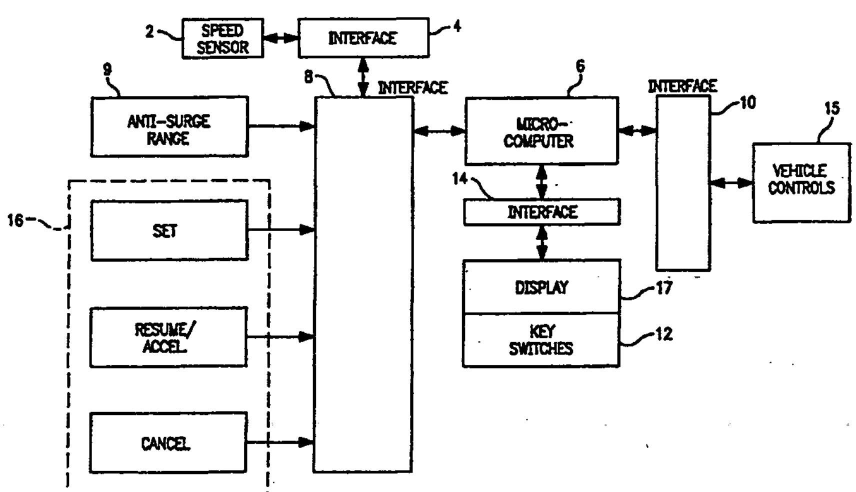


(57) Abstract

A programmable cruise control for a vehicle having means for sensing the speed of the vehicle (2), a microcomputer (6) with operating software, timing, memory, and input–output circuitry, receiving speed information from the speed sensing means (2) and connectable to cruise control apparatus, and means for controlling the speed of the vehicle (15) connected to the microcomputer (6). There is an input device (12) and a display (17) both attached to and controlled by the microcomputer. One or a plurality of speed settings may be inputted and stored in the microcomputer memory. The stored speed settings may be selected and shown on the display (17), and one of the speed settings may be activated to become the cruise control speed. The microcomputer (6) controls the means for controlling the speed of the vehicle (15), whereby the vehicle travels at the activated speed setting, unless the instantaneous speed is below the activated speed by a pre–selected amount. There are also anti–surge, anti–spin and anti–skid embodiments of the invention.

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# PROGRAMMABLE CRUISE CONTROL WITH PROTECTION AGAINST SURGE, SPIN and SKID

## Field of the Invention

The present invention relates generally to cruise control in vehicles and, more particularly, to a cruise control with multiple programmable speed settings that are stored and activated as desired, including protection against surge and spin-out and skidding.

## Background of the Invention

Speed or cruise controls for automobiles and other vehicles have been in existence for many years, and many patents have been issued on cruise control systems. These prior patents have been aimed at the mechanisms for implementing cruise controls, ways of effecting the transitions to and from speed settings, and certain other comfort and safety issues. Patents have also been issued in the related art of setting speed limits.

One of the patents including setting speed limits is found in U.S. Patent No. 3,878,915 to Purland et al., entitled "Electronic Motor Vehicle Speed Control Apparatus" which was issued in

1975 and was assigned to Digi-Gard of New Hope, Minn. This patent discloses an electronic speed control with a keypad to input codes representing different drivers. When the control is activated, the vehicle will not exceed a pre-defined speed for a specific driver. In this patent the idea is to have third parties determine the maximum speed that a certain driver may not exceed, e.g., an insurance company for, say, a higher risk policy holder. There are serious safety issues not addressed in this patent, and the alleged advantages of this patent have not been realized.

Patents have been issued directed to the mechanisms involved with cruise control systems. One such is U.S. Patent No. 5,552,985, entitled "Cruising Control Apparatus," to Hori, issued in 1996. This patent discloses a microcomputer cruise control including a "watch dog" operation and predetermined upper and lower speed limits. Operations outside normal parameters, abnormal signals and other logical decisions are detected, and responses are carried out by the micro-computer, primarily for safety considerations.

Voice command in connection with cruise control is disclosed in U.S. Patent No. 4,797,924 issued Jan 10, 1989, for a Vehicle Voice Recognition Method and Apparatus, in which

many functions of an automobile are performed by voice command, such as opening and closing windows, turning lights on and off, trunk release, power seat, wipers, and the like. One of the many functions included is cruise control. There is a cartridge with the basic commands already programmed, and the user repeats each command in a specified sequence three times in order for the device to "learn" the users particular pronunciation of each of the command words.

Another prior patent of interest is U.S. Patent No. 5,592,385 for a "Vehicle Cruise Control System With Voice Command" to Katayama et al, issued in 1997. It discloses a cruise control system using voice commands, and in which the driver must first obtain the desired speed and then give a voice command to set the speed. There is also provision for recognition of the voices of different drivers. However, using the disclosure of this patent, speed settings cannot be accomplished when the vehicle is stopped.

Prior application Serial No. 08/850,916, filed May 2, 1997, which is co-pending herewith, discloses a programmable cruise control integrated into the vehicle's microprocessor memory.

It is a common practice for there to be a speed limit below which neither the activation nor resumption of cruise control

will work. The clear objective of such a minimum is safety. But, for a given vehicle that is a fixed speed and one which is relatively low, such as 25 mph, which may be quite far from the resumed cruise control speed. This can lead to problems of surge and spin-out, both of which can compromise safety.

The term "acceleration," as used herein refers to both positive and negative acceleration (the negative is popularly referred-to as "deceleration."

## Summary of Invention

It is an object of the present invention to provide a system, controlled by a micro-computer, into which an array of cruise control speed settings can be inptted or stored.

It is also an object of the present invention to provide a programmable cruise control system with settings that are selectably inputted, activated and displayed.

It is a further object of the present invention to allow a plurality of speeds to be set both when the vehicle is stopped and while it is moving.

It is another object of the present invention to provide means to display and edit or change the stored speeds and to provide means to enable groups of selected speeds, as desired by the operator of a vehicle.

It is yet a further object of the present invention to allow use of the standard controls and apparatus now in use in typical cruise control systems.

It is a still further object of the present invention to provide a cruise control in which the surge range can be reduced and can be tailored to the operator's preference, but within a pre-programmed set of boundary conditions.

It is another object of the present invention to provide a cruise control in which under special, pre-defined circumstances, braking can be applied by the system.

It is a further object of the present invention to provide an anti-spin function in conjunction with cruise control, as well as a related anti-skid function on the brakes.

An additional object of the present invention is to provide an improvement in both safety and convenience over the prior art.

The objects of the present invention are met in a programmable cruise control system, using the speed sensors as found in the many standard cruise control and other vehicle systems. However, a means is provided for inputting and storing a plurality of speed settings in memory. Once stored in memory, the settings may be individually activated, reviewed, edited or

changed, as desired. The present application extends the concept of the previously mentioned co-pending application to include programmable anti-surge protection and an automatic anti-spin capability.

The operator is provided with means for selecting one of the saved speed settings. The operator may then activate the cruise control which is responsive to the setting, whereby the vehicle travels at the selected speed setting.

One embodiment includes a microcomputer, an input device, which could be a keyboard or keypad, with display, requisite interfaces from the speed sensor, typical cruise control inputs, and typical interfaces to the accelerator and brake. In another embodiment, the "cancel," "resume," and "set" inputs, as known in the art, may be implemented as key inputs on the keyboard/display peripheral to the micro-computer.

In another embodiment the setting and displays may be dial potentiometers, where the dials are scaled to read speeds. The setting of the potentiometer is, in effect, a stored cruise control speed value. The system need only access the selected potentiometer to re-read the desired speed. The system may be a programmable microcomputer, where, in response to the selected and activated speed control, the system causes the vehicle to

attain and maintain the selected speed. As described later, other controls or functions may be provided to adjust the cruising speed. As noted before, the operation of the cruise control apparatus to control the accelerator, to cancel when the brake is applied, and to respond to such other typical cruise control signals found in the art, would remain unchanged.

In another embodiment, groups of speed settings, each associated with a different driver, may be programmed and used. Other functions including speed limits and associated alarms may be implemented.

In a particularly useful arrangement, protection against surge is provided. The difference between the vehicle's current speed (which may be zero) and a putative cruise control speed will be called "delta." Then, with this new anti-surge protection, the vehicle will not accelerate to any designated cruise control speed (whether new or "resumed") unless the delta is small enough. What constitutes small enough is programmable and, therefore, up to the driver's discretion.

Different settings can be retained in memory for different drivers. There can be a default setting such that, if not otherwise programmed, the delta is automatically set for, say, 10 mph or 20

mph. The operator will also be able to program off this anti-surge or delta function.

One embodiment also includes automatic wheel spin reduction and skid reduction protocols and mechanism. When a cruise control speed is targeted, or the "resume" function is activated, there would be a limit on the rotational acceleration of the drive wheels. If the vehicle is on a low friction surface, the limiting function would reduce the likelihood of a spin-up or spin-down and consequent loss of control of the vehicle by the driver.

Other objects, features and advantages will be apparent from the following detailed description of preferred embodiments, taken in conjunction with the accompanying drawings in which:

## Brief Description of the Drawings

FIG. 1 is a block diagram of the hardware implementation of one embodiment of the present invention

FIG. 2 is a schematic/block diagram of one manner of carrying out the embodiment of FIG. 1.

FIG. 3 is a frontal view of the FIG. 1 embodiment of the input and display panel of the present invention.

FIG. 4 is a block diagram of a system for a spin and skid reduction system according to the present invention.

FIG. 5 is a block diagram of a system according to the present invention for automatic braking control under certain circumstances of cruise control operation.

## Detailed Description of Preferred Embodiments

FIG. 1 is a block diagram of a preferred embodiment of the invention. There is a speed sensor 2 connected to a microcomputer 6 with associated support chips (memories, A/D's, other converters, buffers, interfaces, etc.), all known in the art. The signal output of speed sensors can be analog or digital. If the output is analog, the interface 4 includes an analog-to-digital converter (A/D) that converts the analog speed signal to a digital value that is inputted to the micro-computer 6. For this preferred embodiment, such A/D's, may have as few bits as determined by the designer, depending upon the incremental values that may be set for the cruising speeds. For example, in a preferred embodiment eight binary bit converters may be used which can form 256 different combinations and this would allow the speed ranges to be encoded with increments of 1/256 of the range between settings. For example, if the cruise control range were 35

to 65 miles per hour (mph), the differential of 30 mph would be digitized with the least significant bit having the value of a little more than 0.1 mph. In such a case, cruise control speeds may be programmed in 0.25 mph increments. Since 12 bit A/D's are inexpensive and readily available, the 12 bit A/D is a preferred embodiment. With 12 bits the incremental changes allowed would be effectively continuous to the human user. This A/D has the additional advantage of small increments that result in smooth transitions, when speeds are incremented upward or downward. While a driver would not usually be interested in such a fine adjustment of speed, e.g., in 0.1 mph increments, this does show the precision which can be obtained.

The microcomputer may be one of the many one chip or several chip computers known in the art, e.g. see the product lines of Motorola, Intel, AMD, National Semiconductor, and the like. The associated support chips (memories, A/D's, buffers, interfaces, etc.) are also available in the marketplace from these or other such manufacturers.

The A/D and the microcomputer need not be the fastest available, since the human time frame is reasonably slow. The typical speeds of available A/D's and microcomputers with clock speeds in the 10 MHz range will suffice.

There is an interface 8 to the CANCEL, SET, and RESUME/ACCELERATE buttons or switches or controls 16, and an ANTI-SURGE RANGE button or switch or control 9 which could also be separate as shown in FIG. 1. The CANCEL, SET and RESUME/ACCELERATE buttons, are common in cruise controls. In this embodiment those controls are inputted to and used by the microcomputer in order to control the accelerator or the fuel injection or carburetor systems to change the state of the cruise control, as determined by the above referenced controls. Via interface 10 the microcomputer 6 will regulate the vehicle controls 15. The microcomputer will thus control the speed of the vehicle, delay the engagement of or disengagement of the cruise control. In one embodiment, described below in connection with FIG. 5, it will control deceleration by using the brake under controlled conditions.

There is a set of key switches or a keyboard 12 and a display 17 connected to the microcomputer 6 by an interface 14. In other embodiments the keyboard and display may share the interface 8 of the cruise controls 16. In some known systems there is a display indicating when the cruise control is activated. In those systems, display 17 could share the existing display.

FIG. 2 shows another design for setting, saving and displaying cruise speeds, using three potentiometers 18, 20, and 22, coupled respectively to dials 24, 26, and 28. In this case the dials are calibrated and marked in miles per hour (mph), but in another preferred embodiment marking may be in kilometers per hour (kph). In FIG. 2 the speeds "55," and "60" and "65" are shown on the dials, but any number of speeds may be shown. Unless changed by the users, the dials remain at their settings, and the settings are saved inherently. More or fewer potentiometers and dials could be used in other embodiments. In this example the dials are the actual display, but any of the digital or other such mechanical displays may be used to advantage. For example, such displays may include, but are not limited to, LED's (light emitting diodes), LCD's (liquid crystal displays), fluorescent types, bar type displays, and any of the mechanical displays that use plates which "flip" to form different numbers.

The potentiometers are connected between ground 30 and the twelve volt car battery 32 and form voltage dividers. Voltage regulators and filters may be used, as required, and as known in the art. Each voltage divider feeds a voltage signal to an A/D converter, built into interface 36, that forms a digital signal 38 for inputting into the microcomputer 40. In this embodiment the

microcomputer program has reserved different addresses for storing the digitized settings of the three potentiometers in the memory of microcomputer 40. The user may select and activate one of the stored speeds from the keyboard 52 via interface 54. In response to the activated stored speed, the microcomputer 40 directs output control 42 to command the accelerator 44, and/or other such cruise control hardware, to implement cruise control of the vehicle at that activated speed. In this arrangement the feedback of the speed signal 46 from the speed sensor 48 is fed via interface 50 to the microcomputer, wherein the program will complete the feedback control loop.

Selection of another speed may be accomplished by depressing a button or activating a switch, and the entire system may be operated with controls known in the art. Other embodiments may have the microcomputer receive the desired speed settings and output those settings to the equipment already existing in a vehicle. In these cases the feedback controls would be those which were originally installed in the vehicle.

FIG. 3 shows an integrated front panel 56 with switches, a keypad 60, LED indicators 68, and displays 62 that incorporate the means for effecting cruise control operation. Three or four digit displays may be used and fractional mph or kph settings are

possible. The displays 62 are preferably three or four digit LCD's or equivalent LED's, and the keypad and switches are preferably a spill resistant film type. The three digits allow incremental settings of 1/10 mph up to 99.9 mph as a maximum setting. Three digits also accommodate displays of speed in kph without tenths displayed. Four digits are preferred if tenths of kph are to be displayed, one hundred kph being about 62 mph. Three different speed settings are shown, but more or fewer could be used. The three LED's 68 indicate which display 62 is selected.

In one manner of operation, to program cruise control speeds into the memory, the first driver presses the ENTER button 70, then the DRIVER button 86, and "1" on keypad 60. (Henceforth, numbers in quotations refer to buttons on keypad 60.) The LED by the first display lights; the driver enters the digits for the first speed to be stored. If a mistake is made, pressing the CLEAR button 72 allows the person to start over. After the digits are entered, the "select" SEL button 66 is pressed to move to the second display, and so on. When programming is complete, ENTER 70 is pressed again to set all the data into memory. The second driver presses ENTER 70, DRIVER 86, "2" and proceeds similarly. Of course, there can be more speeds stored than those displayed.

To recall a driver's group of speeds, the first driver presses DRIVER 86, "1," the second presses DRIVER 86, "2," etc. Alternatively, repeatedly pressing DRIVER 86 will sequence through the stored groups of speeds. The driver may sequence through the displays by iteratively pressing SEL 66. When selected by the LED, the corresponding speed displayed may be changed via the keypad 60. ENTER 70 is pressed followed by digits for the new speed. Pressing ENTER 70 again sets the new value into the selected display. CLEAR 72 may be used to clear the display values.

To run the vehicle under cruise control at a programmed speed, the operator sets or has the desired speed indicated on the selected display. He presses the ON switch 74, activating the cruise control. Then he presses SET 82 to cause the cruise control to adopt the selected speed. The ON switch 74 may be self-lighted to show that the cruise control is ON, or another display (not shown) may be activated to show that the cruise control is operating, as is known in the art. There may also be an OFF switch 76. When cruise control is operating at one of the programmed speeds, the LED 94 next to that displayed speed lights to indicate that it is now the cruise control speed.

Depressing SEL 66 selects the next programmed speed which is displayed in the next display in sequence. Pushing SET 82 then causes the cruise control to operate at the newly selected speed, and LED 94 changes accordingly. The operator can shut off the cruise control memory by pressing, say, the DRIVER button 86 twice or by some other convenient entry or entries, or there can be a separate on/off switch (not shown). If the vehicle is moving (perhaps above some pre-determined minimum speed), the operator can shut off the cruise control memory, press the SET button 82 and cause the system to take the existing speed as the cruise control speed. The LED's 68 will then all be unlit to indicate that none are selected and active. Alternatively, if the vehicle is operating at one of the programmed speeds, or the operator changes speed, up or down, pressing the SET button 82 will cause the cruise control to operate at this new (unprogrammed) speed.

In a modification of this embodiment this cruise control speed can be "read" by the microcomputer and presented either in the first of the displays 68 or in another separate display (not shown). LED 68 and LED 94 next to the display are lit. This speed can then be stored in memory by pressing ENTER 70. It will be added to the operator's programmed list or stored separately, if no

driver number has been entered for the operator. It can be retrieved by pressing DRIVER 86, "0" or by some other convenient entry or entries.

In another embodiment only one display is used. Then FIG. 3 would be modified to have only one display 62, one indicator 68 and one indicator 94. In this case, the first driver presses ENTER 70, DRIVER 86, and "1" to initiate entry of his particular cruise control speeds. Then he enters the digits for his first cruise control setting. When the first entry is complete, he presses SEL 66, which clears the display and sets up entry of the second cruise control speed, and so on. If a mistake is made, pressing CLEAR 72 will allow him to start that entry over. When all entries are complete, he presses ENTER 70 again to set the entered speeds in memory. Or, the system can be designed such that the driver can press ENTER 70 after each entry. He presses the ENTER button 70 twice after the last entry to complete the speed entering process. The second driver begins by pressing ENTER 70, DRIVER 86, and "2" and proceeds similarly for his settings.

The group of stored cruise control speeds for the first driver is recalled by pressing DRIVER 86, "1." After that, pressing SEL 66, "1" displays the first stored speed, and then pressing SET 82

activates the cruise control at that speed. Pressing SEL 66, "2" displays the second stored speed, etc.

To enter a cruise control speed unrelated to a particular driver or previously stored speed, an operator presses ENTER 70, followed by the digits representing the desired speed. Pressing SET 82 activates the cruise control at that speed. To store this speed in memory the operator presses ENTER 70 again. This can be done before or after SET 82 is pressed.

Pressing SEL 66 (not preceded by DRIVER 86 and some keypad number, as above) will recall and display the most recently stored speed not part of a driver's group of speeds. If there is a speed in the display, pressing SEL 66 will display the most recently prior stored speed. Subsequent depressions of SEL 66 will display the stored speeds in order of storage, last to first. When all stored speeds have been presented, the next depression of SEL 66 will yield zeroes or blanks. Any speed displayed (usually above some minimum) can become the cruise control speed by pressing SET 82.

Cruise control operation can be canceled by depressing CANCEL 80 or by touching the brake and may be resumed by pressing RESUME/ACCELERATE 84. When operating under cruise control, depressing RESUME/ACCELERATE 84 may

incrementally boost the speed from any given setting, as is known in the art. Since all these controls are handled by the computer, many other such modes may be implemented.

The knob 78 may be used to increment or decrement the cruise control speed. The knob may be spring loaded, so that the speed may be changed by turning the knob against the spring until the desired new speed is attained. Then, the knob is released and returns to the center, neutral position. Alternatively, knob 78 may have discrete settings, each adjusting the cruise control speed up or down incrementally for each step clockwise or counterclockwise. In another preferred embodiment there are "+" and "-" buttons on keypad 60. Pressing one of those buttons increases or decreases the cruise control speed by a fraction or a unit of mph or kph.

The size of the increments can be pre-set by the manufacturer or programmable by the operator. For the programming option, in the case of the knob 78, pulling it out (against a spring load) displays the current increment setting. Then turning the knob clockwise or counterclockwise increases or decreases the magnitude of the increments. Releasing the knob 78 sets the new value. In the case of buttons on the keypad, pushing "+" and "-" simultaneously displays the current value

and sets up programming. Pressing "+" or "-" then raises or lowers the settings by fractions or units of mph or kph.

As described above, settings may be entered and stored in the microcomputer and shown on the corresponding displays. The list of groups is retained in the microcomputer. If groups of speeds are stored, these groups of speed settings may be selected and activated as described above. In this way different people who drive the same vehicle may circulate through the settings to find their preference and have it displayed and available for use. In another preferred embodiment the programming of the groups may be accomplished by other known techniques.

Several different mechanisms may be incorporated for editing and updating the lists. In another embodiment, when a new set of speeds is to be entered, the operator depresses ENTER 70 twice in quick succession or holds ENTER 70 or DRIVER 86 or SEL 66 depressed for a given length of time, and the microcomputer accesses addresses where a new group of three speeds may be entered. Other programmable operations for editing the stored speeds may be implemented.

With the microcomputer controlling all the switches, displays and operations, many different variations of cruise control operation may be implemented. Additionally, other

functions may be accommodated by the microcomputer. For example, extended keypads or even keyboards may be implemented to allow programming of many functions within an automobile, including speed limits and indicators, and interlocks with codes to prevent unwanted users from driving. Records of who, when and how many miles may be kept by including a time/date clock with a battery back up, etc.

Speed limits may be included by another function button that selects speed limits and an indicator light or buzzer that is activated when the speed limit is exceeded. The indicators may be disabled by programming, since such indicators may become bothersome to some drivers. The microcomputer can easily perform such functions. A LIMIT button 90 is shown for programming speed limits. Depressing LIMIT 90 causes the microcomputer to access a location. A limit may then be entered on the keypad and displayed. The limit function display may be indicated by lighting the LIMIT button 90 itself. A separate limit switch 92 with ON/OFF indicator may be used to activate or deactivate the limit function.

In any event, the CANCEL switch 80 may be physically connected to a mechanical interrupt which disables the cruise control for safety. Re-connecting may be accomplished in various

ways as the system designer may wish. One way is to re-connect by depressing RESUME/ACCELERATE 84.

Protection against surge is also provided. When the cruise control is turned on, the anti-surge protection is in the default position, i.e., it is on and set to the default delta. The "ON" switch or button 96 is lit, and the default delta is shown in display 98.

To shut off the anti-surge mechanism completely (i.e., so that the delta extends from the lower limit of the operable cruise control range), the operator can press the ANTI-SURGE OFF button 102. The system can be turned on again by pressing ON 96.

To change the delta, the first driver presses RANGE SEL button 100, which lights to indicate the anti-surge range can now be programmed, followed by DRIVER 86 and "1" on keypad 60. He then enters the desired range via keypad 60; the entered digits are displayed on RANGE display 98. To start over, pressing CLEAR 72 clears the display. When the digits are entered satisfactorily, he presses RANGE SEL button 100 again. This sets the entered and displayed digits as the new delta in the car's computer memory.

Alternatively, the RANGE SEL button 100 could be simply a LED next to the RANGE display 98, and the previously described

RANGE SEL 100 function could be incorporated into the ENTER 70 and SEL 66 function (cf. Application No. 08/850,916). In this embodiment, after scrolling through the cruise control speed displays via SEL 66, the next pressing of SEL 66 would illuminate the range select LED 100 indicating the delta could be changed following the same step as before, ending with pressing ENTER 70 again.

In the first embodiment, if the DRIVER 86, "1" sequence is not included, the delta range will still be set but will not be recallable as part of a driver package. If the car engine is shut off, then turned on, the default delta appears and is the entered delta, when the cruise control is turned on. To recall the previous delta, the operator presses ANTI-SURGE ON 96. To recall his personal anti-surge setting (along with his cruise control settings), the first driver presses DRIVER 86, "1"; the second driver presses DRIVER 86, "2", etc.

To recall the default setting, the operator presses ANTI-SURGE ON 96 again. When the anti-surge protection system is on, with each pressing of ANTI-SURGE ON 96 the RANGE display 98 alternates between the default delta and the most recently entered other delta (Alternatively, there can be a separate DEFAULT button, not shown, to reclaim the default delta).

It is known that when surface friction is low, less rotating power must reach the driven wheel(s), otherwise it will spin-up and lose its rotational motion in favor of the much less controllable sideways or skidding motion. By reducing the rate of acceleration through the available cruise control components, the wheels regain their rotational motion, and the driver regains control.

Based on current art, and available wheel speed information, one can have a table of acceleration versus time stored in a memory-chip. When the rate exceeds a predetermined threshold, the system reduces the rate of acceleration. The system is automatic, the driver has no input to enter, nor does he have to exercise any other control function. The simple act of engaging the system activates the spin reduction control feature. Any previously inputted deltas can be made subject to automatic change by the system.

The surge and spin control embodiments of the system can be visualized as shown in FIG. 4. There is input by a mechanical, electronic or voice command process 103 into a voice recognition circuit 104 or a keypad and/or an A/D filter 106, to a signal generator 108 which goes to a unit or chip 110 performing several functions. It is a programmable chip with memory and a

comparator, where a surge/spin reduction system element can be incorporated. It will receive information regarding and set the delta. It will also avoid too great a vehicular acceleration or deceleration, the amounts being set by stored thresholds in the chip 110. The wheel speed 111 is fed into an A/D unit 112 to a clock 114 and to the chip 110. The clock is used for the controller 116 and also for the chip 110. From the controller the signal travels to the actual mechanism being controlled 118 which feeds back to the controller and to the chip 110.

The embodiment shown in FIG. 5 applies when deceleration is required. The cruise control device of the present invention will then apply the vehicle's brakes. This can be useful, for example, when the crest of a hill has been passed after traveling uphill. The vehicle then heads downhill and increases speed due to the downward incline. This may cause the vehicle to travel at a speed greater than that called for by the cruise control. Under such circumstances a driver either accepts the higher speed or must use the brakes, thereby disconnecting the cruise control. He may later push the RESUME button. With the embodiment of FIG. 5, however, the brake is applied by the cruise control system. The amount of braking depends upon the size of the difference between actual speed and the set speed. The greater this

difference the more braking is applied, within limits for safety reasons.

When the system receives information that the vehicle has excceeded the rate vs time of the set speed, the accelerator is retarded. If the speed overshoot is above a certain amount and if the rate of vehicle speed slow-down, due to the drag of "engine braking," is below a pre-programmed rate, the system sends a solenoid a signal to apply the brakes until the vehicle is once again at the cruise control speed. The system differentiates between when the driver applies the brakes as against when the brakes are applied by the system. This is accomplished by using a pressure switch on the brake pedal or by other known means. This allows the vehicle to remain in cruise control while the brakes are applied by the system.

FIG. 5 shows a block diagram in which a speed sensor 120 obtains speed information 124 from wheel 138. The speed sensor 120 feeds this information in a suitable form to the microprocessor 122 which controls a solenoid 128 in a pre-selected manner for pre-selected conditions. The solenoid 128 operates a brake controller 130 which actuates the brakes through brake line 140, the same line in which the master cylinder 136 is active. Since a solenoid is used, there is an "on" and "off" action of the

controller 130 on the brake. Should this action create a situation in which the negative acceleration is too great, the microcomputer controls the solenoid to release the brake. When the negative acceleration is no longer present, the solenoid is again actuated. This action continues quickly and repeatedly (if needed) in such manner that the passengers do not feel any surges. The action of controller 130 is similar to that when the brake pedal 132 is actuated by the driver, except that when the driver actuates the brake pedal 132, the cruise control is turned off or disengaged, whereas when the solenoid 128 operates braking, the cruise control remains engaged. A pressure sensor 134 on brake pedal 132 tells the microprocessor when the brake pedal is depressed. Since the brake pedal is not depressed when the brakes are actuated by the solenoid, the cruise control is not disengaged when braking is by the system rather than by the operator of the vehicle. Information pertaining to the actuation of solenoid 128 may be fed to various locations generally designated 126, which may include the vacuum supply, the accelerator, and the "shifter."

Should the vehicle accelerate too fast in a positive sense, traction control is provided to reduce the amount of positive acceleration.

It is possible to have a voice command input system for a programmable cruise control as shown, for example, in FIG. 4. U.S. Patent No. 5,592,385 proposes a system where speed settings are inputted audibly, when the vehicle is traveling at target speeds. A better way to use an audio system would be to input the speeds when the vehicle is not moving. This can be accomplished by inputting a cruise control speed on a keypad and then speaking it. The voice recognition system then correlates the two and communicates appropriately with the microprocessor. Another way is to store at installation a generic dictionary of speeds over the desired range of cruise control usage. Then the relatively modest adjustment to a particular operator's voice pattern is made when the operator verbalizes the specific speed, preferably, but not necessarily, when the vehicle is stationary.

While voice command has some appeal, it may not be advisable to have such a system alone. First, an operator may have laryngitis and/or not have voice enough to issue the requisite instructions. Second, there may be too much noise in the cabin for even a good directional microphone, for example, if a radio is playing or the occupants are noisy. Third, there are times when an oral interjection or interruption of a conversation

is inappropriate, even rude. Therefore, the voice command embodiment of this system has a keypad system in addition or as a backup.

It will now be apparent to those skilled in the art that other embodiments, improvements, details and uses can be made consistent with the letter and spirit of the foregoing disclosure and within the scope of this patent, which is limited only by the following claims, construed in accordance with the patent law, including the doctrine of equivalents.

## Claims

1. In a cruise control for a vehicle including a means for sensing speed and a means for controlling the speed of the vehicle with the cruise control, the improvement comprising:

means for inputting a plurality of speeds selectively, when the vehicle is at rest and when the vehicle is moving,

means for storing said plurality of speed inputs;

means for selecting one of said plurality of speeds, wherein the cruise control, responsive to said selected speed, causes the vehicle to travel at said selected speed.

2. The improvement of claim 1, further comprising means for preventing the vehicle from accelerating to said selected speed when the instantaneous speed is below said selected speed by a pre-programmed amount or when acceleration vs. time exceeds a preset value.

3. The improvement of claim 2 further comprising means to change incrementally the cruise controlled traveling speed.

4. The improvement of claim 2 wherein the means to change incrementally is an electronic device.

5. The improvement of claim 2 further comprising means for braking, within preset boundaries, the vehicle when the traveling speed exceeds the selected speed by a pre-selected amount. 6. The improvement of claim 5 wherein said means for selecting selects one of said stored speed settings.

7. The improvement of claim 2 further comprising:

means for communicating to a user the speed settings,

means for communicating to a user said pre-selected amount, and

means for indicating which speed setting is selected and activated.

8. The improvement of claim 7 wherein said means for communicating the speed settings is a display.

9. The improvement of claim 7 wherein said means for communicating the speed settings is an LED or LCD display.

10. The improvement of claim 2 wherein the means for setting and storing said speed settings comprises an electronic device.

11. The improvement of claim 2 further comprising means for grouping said plurality of speed settings, and means for

selecting and displaying each grouping, wherein each grouping is identified with a different person.

12. The improvement of claim 2 wherein the means for setting comprises an input device and wherein said means for selecting comprises a microcomputer programmed to accept input from said input device and to save said inputs in said microcomputer memory.

13. The improvement of claim 12 wherein all settings are displayed and wherein said activated speed setting is displayed and indicated.

14. The improvement of claim 2, further comprising a microcomputer with operating software, timing, memory, and input-output circuitry receiving speed information from the speed sensing means and connectable to the cruise control;

an input device and a display both attached to and controlled by said micro-computer, wherein the plurality of speed settings is inputted from said input device and stored in the microcomputer memory, and wherein said stored speed settings may be selected and displayed on said display under the control of the micro-computer, and wherein one of said speed settings may be activated, and responsive to said activation, and said micro-

computer controls the means for controlling the speed of the vehicle, whereby said vehicle travels at said activated speed setting unless the instantaneous speed is below said activated speed by a pre-selected amount.

15. A method of programming and controlling the speed of a vehicle comprising the steps of:

activating the means for controlling the speed of the vehicle,

setting and storing a plurality of speeds,

selecting and activating one of said speeds,

acquiring speed information, and

controlling the speed of the vehicle, responsive to one of said plurality of speeds.

16. The method of claim 15 further comprising the step of preventing the speed from increasing when the difference between the desired speed and the current speed is more than a pre-selected amount, and wherein said step of controlling the speed of the vehicle, responsive to one of said plurality of speeds, in not done when the instantaneous speed is below said set speed by a pre-selected amount.

17. The method of claim 16 further comprising the step of controlling the rotation of the wheels to prevent the wheels from spinning upwards or downwards.

18. The method of claim 17 further comprising the step of braking the vehicle when the actual speed is more than the set speed by a pre-programmed amount.

19. The method of claim 15 further comprising the steps of:

displaying the speed settings, and

indicating which speed setting is selected and activated.

20. The method of claim 15 further comprising the step of:

incrementally adjusting the speed of the vehicle.

21. The method of claim 15 further comprising the steps of:

setting groups of speed settings,

identifying each group with a different driver, and

activating a group identified with a given driver.

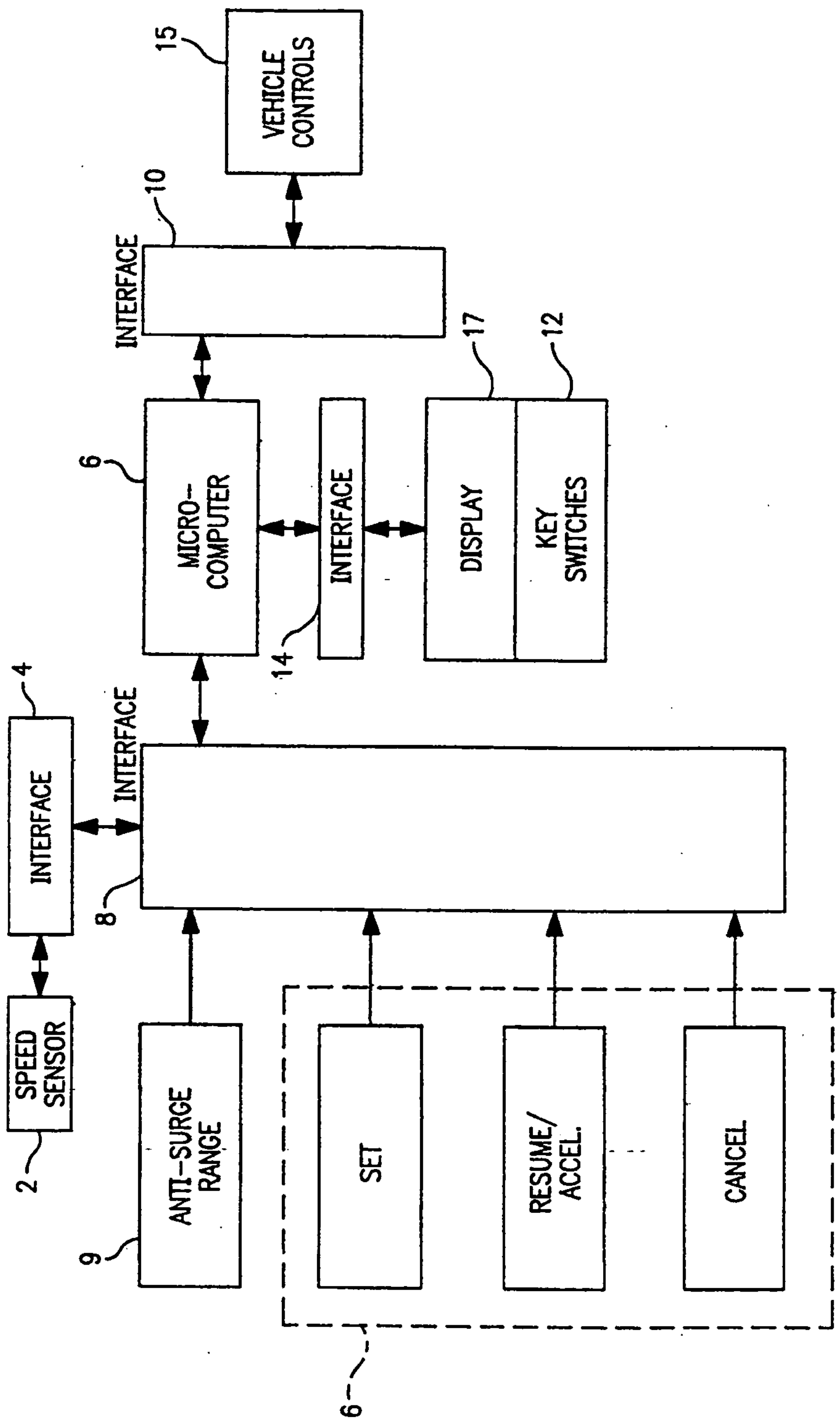
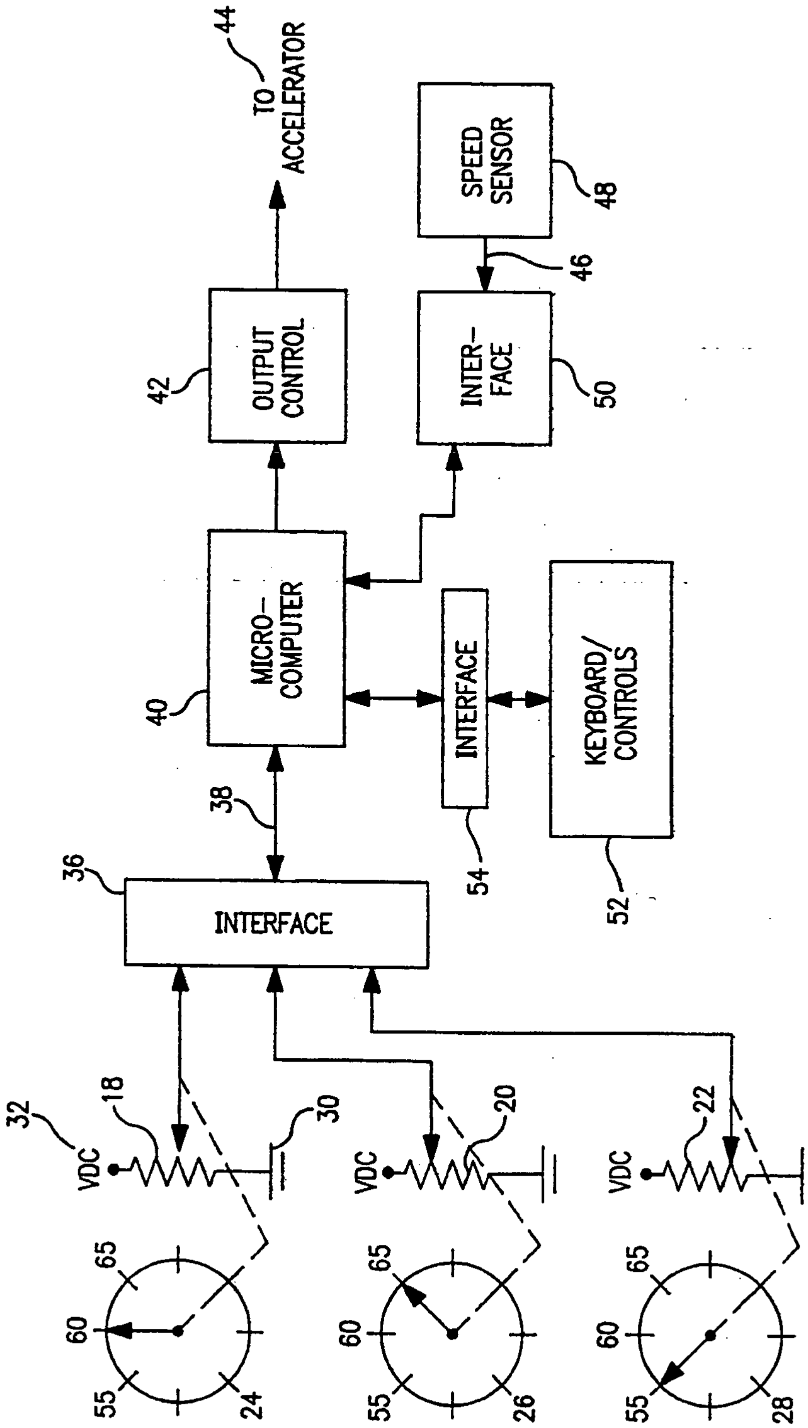

VEHICLE CONTROLS
15
INTERFACE
10
MICRO-COMPUTER
6
INTERFACE
14
DISPLAY
17
KEY SWITCHES
12
INTERFACE
4
INTERFACE
8
SPEED SENSOR
2
ANTI-SURGE RANGE
9
SET
RESUME/ACCEL.
CANCEL
16

FIG. 1


TO ACCELERATOR
44
SPEED SENSOR
48
46
OUTPUT CONTROL
42
INTER-FACE
50
MICRO-COMPUTER
40
INTERFACE
54
KEYBOARD/ CONTROLS
52
38
INTERFACE
36
VDC
32
18
30
VDC
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VDC
22
60
65
55
24
60
65
55
26
60
65
55
28

FIG. 2

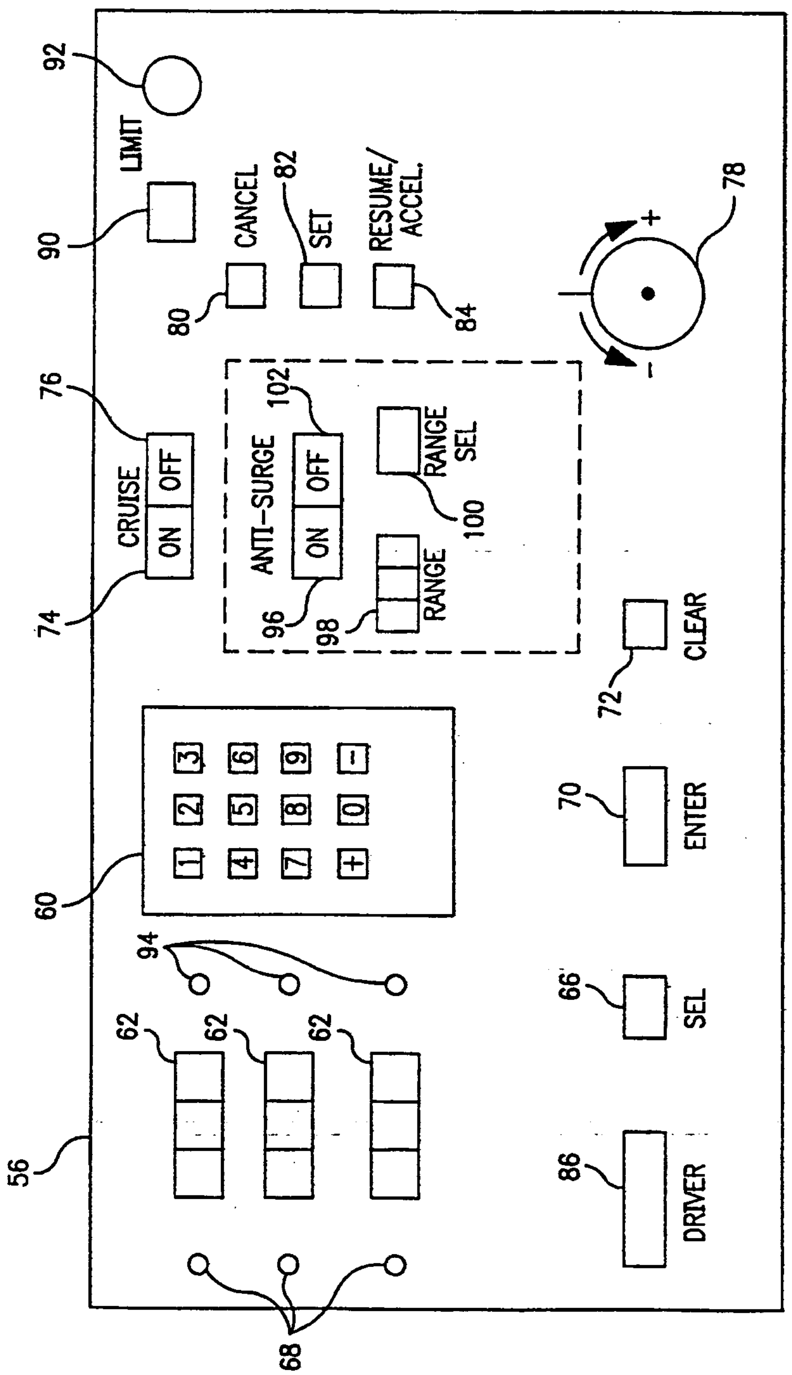
92
LIMIT
90
CANCEL
82
SET
RESUME/
ACCEL.
80
84
78
+
-
76
CRUISE
ON
OFF
74
102
ANTI-SURGE
ON
OFF
96
RANGE
SEL
100
RANGE
98
CLEAR
72
60
1 2 3
4 5 6
7 8 9
+ 0 -
70
ENTER
94
66
SEL
62
62
62
56
86
DRIVER
68

FIG. 3

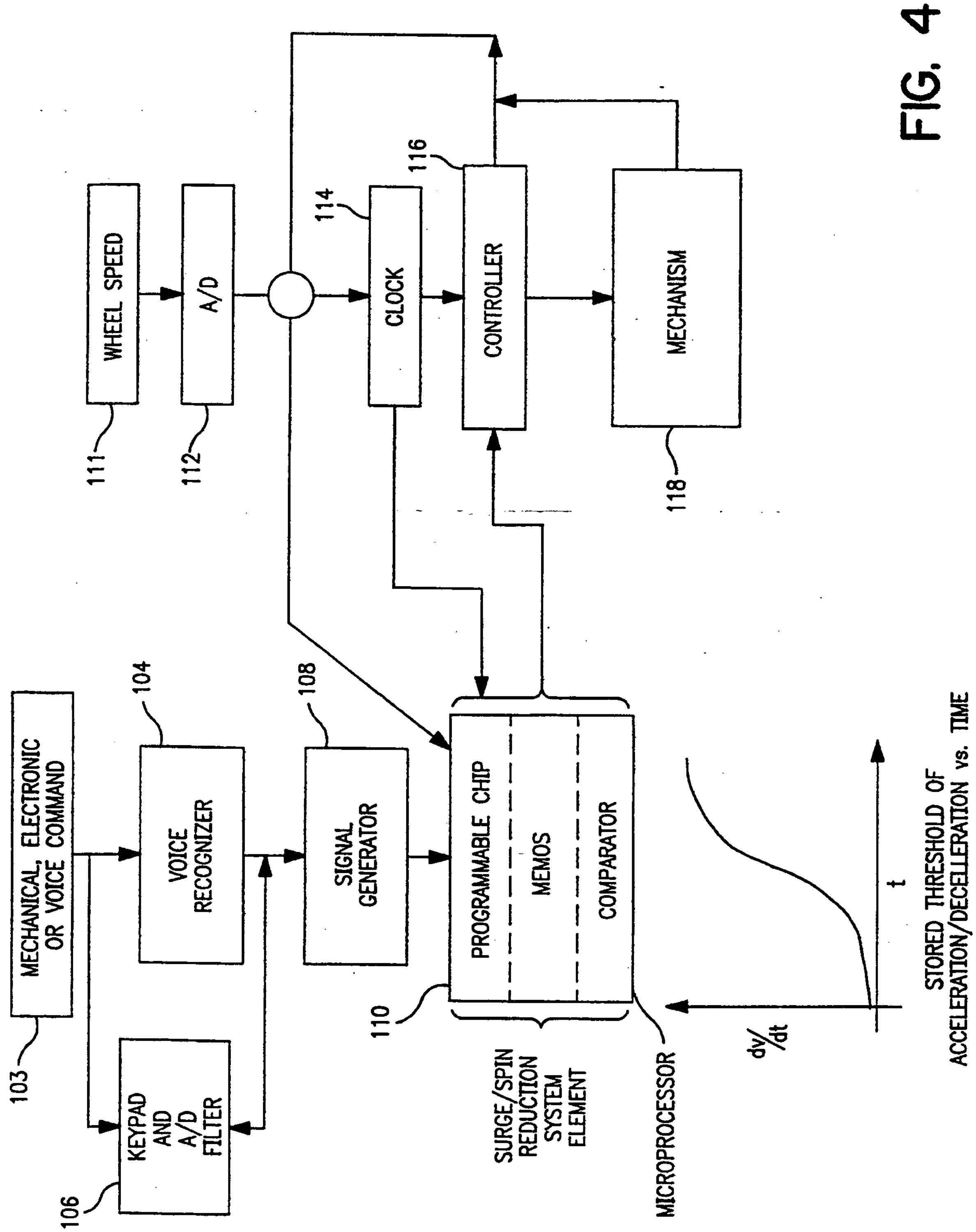
WHEEL SPEED
A/D
CLOCK
CONTROLLER
MECHANISM
111
112
114
116
118
MECHANICAL, ELECTRONIC OR VOICE COMMAND
VOICE RECOGNIZER
SIGNAL GENERATOR
KEYPAD AND A/D FILTER
PROGRAMMABLE CHIP
MEMOS
COMPARATOR
103
104
106
108
110
SURGE/SPIN REDUCTION SYSTEM ELEMENT
MICROPROCESSOR
dv/dt
t
STORED THRESHOLD OF ACCELERATION/DECELLERATION vs. TIME

FIG. 4

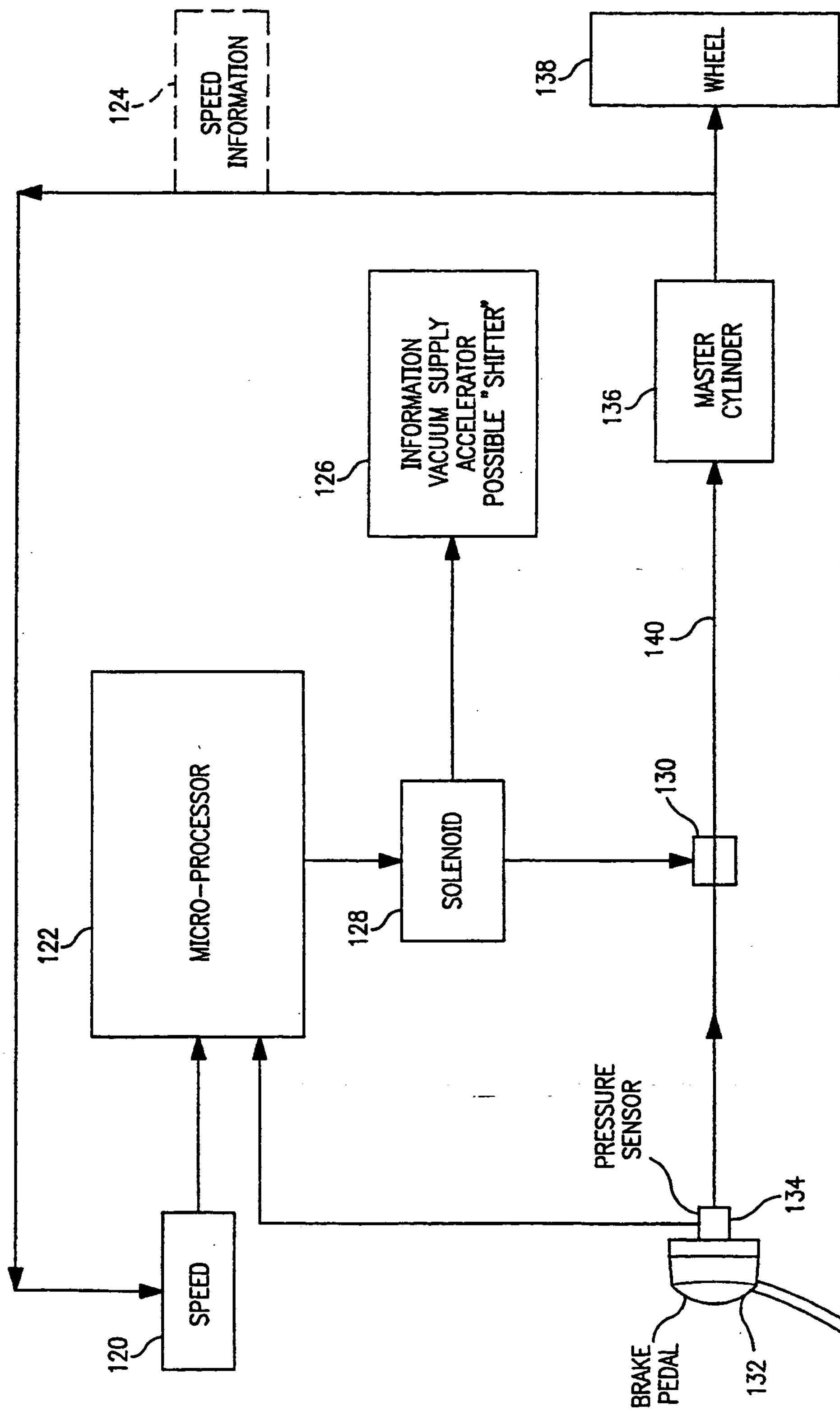
124
SPEED INFORMATION
138
WHEEL
126
INFORMATION
VACUUM SUPPLY
ACCELERATOR
POSSIBLE "SHIFTER"
136
MASTER CYLINDER
122
MICRO-PROCESSOR
128
SOLENOID
130
140
PRESSURE SENSOR
134
120
SPEED
BRAKE PEDAL
132

FIG. 5

## INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/08918

**A. CLASSIFICATION OF SUBJECT MATTER**

IPC(6) :B60K 31/04
US CL :701/93, 48, 91; 180/179; 123/351
According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 701/48, 49, 91, 93, 94, 96, 97; 180/170, 171, 176, 177, 179; 123/351

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| X<br>---<br>Y | US 4,540,060 A (KAWATA et al) 10 September 1985 (10.09.85), figures 4-6. | 1, 15 & 20<br>---<br>2-14, 16-19 & 21 |
| Y | US 4,797,826 A (ONOGI et al) 10 January 1989 (10.01.89), figures 1, 2, 3B and columns 2-3. | 2-14, 16 &18-19 |
| Y | US 4,703,823 A (YOGO et al) 03 November 1987 (03.11.87), column 4, lines 52 to column 5, lines 1-19. | 17 |
| Y | US 4,853,687 A (ISOMURA et al) 01 August 1989 (01.08.89), columns 5-6. | 11 & 21 |

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

| Date of the actual completion of the international search | Date of mailing of the international search report |
|---|---|
| 15 JULY 1998 | 24 AUG 1998 |

| Name and mailing address of the ISA/US | Authorized officer |
|---|---|
| Commissioner of Patents and Trademarks<br>Box PCT<br>Washington, D.C. 20231 | GARY CHIN Diane Smith for |
| Facsimile No. (703) 305-3230 | Telephone No. (703) 308-1113 |

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | US 5,552,985 A (HORI) 03 September 1996 (03.09.96), figure 1. | 1-21 |
| A | US 4,961,146 A (KAJIWARA) 02 October 1990 02.10.90), see the abstract. | 1-21 |
| A | US 5,107,948 A (YAMAMOTO) 28 April 1992 (28.04.92), figure 1. | 17 |